

# GRADING UP THE DAIRY COW BY THE USE OF PURE-BRED SIRES

RESULTS FROM SIXTEEN YEARS OF EXPERIMENT  
AT THE DOMINION EXPERIMENTAL FARM,  
NAPPAN, N.S.

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DOMINION OF CANADA  
DEPARTMENT OF AGRICULTURE

BULLETIN No. 126—NEW SERIES



Grade Holstein cows which have been bred up from common cows by the use of pure-bred sires. Their average production for 1927 was 7,078 pounds of milk, with an average test of 3.72 per cent butterfat.

# **Grading up the Dairy Cow by the Use of Pure-Bred Sires**

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## **INTRODUCTION**

Successful dairying is the result of maintaining at a minimum cost a high average production of milk and butterfat. Statistics show that the average annual production per cow for Canada is about 4,000 pounds of milk, or approximately 160 pounds of fat. Data collected at the Experimental Farm, Nappan, indicate that under average conditions it requires approximately 5,000 pounds of 4 per cent milk to cover the feed cost of a cow. Furthermore, the cow testing associations reveal the fact that there are to-day many high producing herds well over the 6,000 pound average. Therefore, there must be a great many very unprofitable cows being retained on the average farm in Canada.

What, then, is the most economical policy for the average farmer to adopt in order that his herd average may be increased to a profitable point?

The three main factors governing an increase in production are breeding, feeding and weeding. Bearing in mind, then, that the milking propensities of an individual are inherited, not acquired, a carefully thought out policy should be one that would develop these inherited qualities to a maximum.

The selection of the herd sire is undoubtedly one of the first factors to consider in a herd improvement policy. The important part that a sire plays in the development of a profitable herd from average grade cows of very common breeding, is clearly demonstrated in this bulletin, which presents the data collected from a grading-up experiment started in 1911 at the Experimental Farm, Nappan, Nova Scotia.

### **OUTLINE OF THE EXPERIMENT**

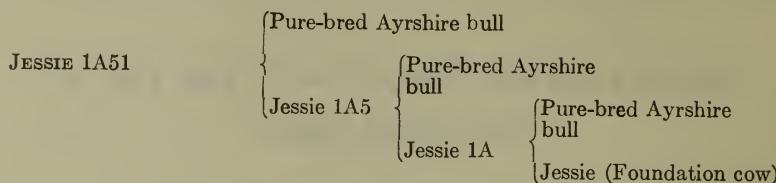
In 1911 eleven common one year old heifers were purchased. The breeding in most cases was of Shorthorn and scrub blood; one gave evidence of being fairly well bred along Holstein lines, and one along Jersey lines. These heifers, (or foundation cows), were first mated to a pure-bred Ayrshire bull. The heifers resulting from this mating were the first-cross Ayrshires. These and subsequent Ayrshire crosses were always bred to a pure-bred Ayrshire bull.

The second mating of the foundation cows was to a pure-bred Holstein bull. These heifers are known as the first-cross Holsteins and they in turn, along with their female progeny, were always bred to a pure-bred Holstein bull.

Thus the two grade herds reported herein were both from the same foundation cows.

A system of nomenclature was adopted wherein the ancestry in the female line was shown in the name of the individual. Each foundation cow was given a name; this name is carried on to each of her progeny with the addition of numerals and letters. The letter A designates the Ayrshire cross and the letter H the Holstein cross. The numeral following the letter A or H designates the cross or generation, also 1st, 2nd or 3rd calf, as the case may be. When the letter S follows the letters A or H, it means the second crop of calves, by a Holstein or Ayrshire bull, from the foundation cows.

The following is the pedigree of Jessie 1A51, a third-cross Ayrshire:—



The name of this cow, Jessie 1A51, shows that she was the *first* calf of Jessie 1A5, who in turn was the *fifth* calf of Jessie 1A (First-cross Ayrshire) one of the first crop of calves from the foundation cows.

All females good or poor were retained in the herd for this breeding test, unless they had to be disposed of on account of injury or disease.

The study covers 343 lactations from 116 cows. Daily records were kept of the milk produced and monthly tests made of the butter-fat content. Individual feed records were kept for all feeds consumed. A uniform set of prices was used in computing the value of the products and the cost of the feeds consumed, so that one record would be comparable with another, even though made during different years.

#### METHOD OF ANALYSIS

The records as compiled and reported in the annual report each year have served to demonstrate to a degree the results obtained, but due to the variation in the length of the individual lactation periods, it would appear in making up this final summary, that a more accurate comparison of each individual would be obtained by using a correcting factor, that is, by bringing all lactations up to a standard length. Consequently, this method was adopted in compiling the data as given in this bulletin. The average length of a lactation was found to be 296 days and this was used as the standard. The production and length of lactation were correlated for each age class; that is, all two-year-old records were correlated with the number of days in their lactation, and so on for each age up to and including the six-year-old records. The regression of milk on days was then computed and this figure used in correcting each record to the standard length, namely, 296 days. This regression of milk on days, is the amount of milk in pounds to add to or subtract from the actual production for each day that the lactation period was below or above the standard of 296 days. The same procedure was followed in correcting the profit over feed cost. The milk records were brought to a "fat corrected milk" (F. C. M.) basis, by using the formula  $.4M + 15F$ ,  $M$  being the amount of milk and  $F$  the amount of butter-fat in pounds.

This formula was derived by Davidson and Gaines<sup>(1)</sup> of the University of Illinois. By so correcting the production to a standard butter-fat content of 4 per cent, as is done by this method, the production records are more directly comparable and only one comparison is necessary. Otherwise two would need to be used, milk and butterfat, and the superiority of daughters over dams would be more difficult to determine. The following are the regression factors as determined by the correlation and regression method:—

#### Regression Factors as Determined by the Correlation and Regression Method

Age	Number of lactations	Regression of milk on days	Factor used	Regression of profit on days	Factor used
2 years.....	116	lb. 19.24	lb. 19	\$ 0.133	cts. 13
3 " .....	73	20.22	20	0.208	21
4 " .....	61	19.33	20	0.214	21
5 " .....	53	21.58	20	0.284	26
6 " .....	40	20.13	20	0.253	26

## THE INFLUENCE OF PURE-BRED SIRES ON MILK PRODUCTION AND PROFITS OVER FEED COST

The study presented herewith is based on a comparison of the production and profit over feed cost of a group of grade cows sired by pure-bred sires and out of common grade cows. From general appearance, the most of the foundation cows gave evidence of having considerable scrub blood of the old brindle type, while one or two gave evidence later on as having inherited milking propensities, for when the feed was supplied in sufficient quantity one or two of these cows responded remarkably well, one going better than 8,000 pounds of milk per lactation and for this reason the average production of the foundation cows was much higher than would be obtained from the common run of grade cows.

All comparisons were made according to the age at which the lactation period was started, and according to the "generation" of the progeny. The Ayrshires and Holsteins are reported separately in tables 1 and 3, but they are combined in table 5. Owing to the few sires used in this experiment, it is not considered practical to make a comparison of breeds. Table 1 gives the corrected average production of all progeny of the pure-bred Ayrshire sires, as compared with their dams. The first column gives the age at which the records were started; the second column the generation or cross of the daughter and dam, which are being compared; column three, the number of individuals compared; column four gives the fat-corrected milk; column five the corrected profit over feed cost; columns six and seven show the percentage of daughters which are superior to their dams in production and profit over feed cost. The last five divisions in table 1 show the average figures for all ages.

**Table 1.—Comparison of the Progeny of Pure-bred Ayrshire Sires with Their Dams on the Bases of "Fat Corrected Milk" produced and "Profit over Feed Cost"**

Age	Generation	Number of dam and daughter pairs	Fat corrected milk	Profit	Per cent progeny superior to dams	
					F.C.M.	Profit
2	Foundation cows.....	11	3,895.5	16 98	64	45
	1st cross Ayrshires.....		3,845.8	14 11		
3	Foundation cows.....	8	5,322.2	32 14	50	38
	1st cross Ayrshires.....		5,033.6	26 82		
4	Foundation cows.....	5	6,027.1	50 17	20	0
	1st cross Ayrshires.....		5,770.3	39 04		
5	Foundation cows.....	6	6,319.9	46 34	0	17
	1st cross Ayrshires.....		5,241.9	37 25		
6	Foundation cows.....	5	5,107.5	31 94	60	20
	1st cross Ayrshires.....		5,290.6	24 10		
2	1st cross Ayrshires.....	21	3,975.2	16 84	43	43
	2nd " "		3,940.0	13 65		
3	1st cross Ayrshires.....	12	5,135.1	28 49	25	42
	2nd " "		4,753.2	23 54		
4	1st cross Ayrshires.....	5	6,213.7	46 61	20	20
	2nd " "		5,780.2	36 39		
5	1st cross Ayrshires.....	6	6,147.5	50 76	50	33
	2nd " "		6,006.3	42 75		
6	1st cross Ayrshires.....	5	5,533.3	29 60	60	80
	2nd " "		7,137.3	61 41		
2	2nd cross Ayrshires.....	15	4,289.4	16 92	80	93
	3rd cross Ayrshires.....		4,892.3	33 95		
3	2nd cross Ayrshires.....	8	5,208.5	34 25	75	63
	3rd " "		5,721.4	45 52		
4	2nd cross Ayrshires.....	6	5,668.6	45 72	50	83
	3rd " "		6,401.1	53 79		
5	2nd cross Ayrshires.....	6	6,269.9	48 11	67	67
	3rd " "		6,901.9	60 72		

**Table 1.—Comparison of the Progeny of Pure-bred Ayrshire Sires with Their Dams on the Bases of “Fat Corrected Milk” produced and “Profit over Feed Cost”—Concluded**

Age	Generation	Number of dam and daughter pairs	Fat corrected milk	Profit	Per cent progeny superior to dams	
					F.C.M.	Profit
			lb.	\$	%	%
6	2nd cross Ayrshires.....	5	7,114.0	61.07	80	80
	3rd     “     “     “ .....		7,377.5	67.04		
2	3rd cross Ayrshires.....	7	4,295.0	19.14	57	71
	4th     “     “     “ .....		4,706.2	35.16		
3	3rd cross Ayrshires.....	5	5,379.7	35.67	100	100
	4th     “     “     “ .....		5,590.9	46.42		
4	3rd cross Ayrshires.....	4	5,391.0	34.05	100	75
	4th     “     “     “ .....		5,863.4	41.43		
5	3rd cross Ayrshires.....	4	5,873.3	41.67	75	75
	4th     “     “     “ .....		6,637.3	49.04		
6	3rd cross Ayrshires.....	2	6,432.2	54.04	50	50
	4th     “     “     “ .....		7,278.5	52.35		
2	4th cross Ayrshires.....	3	4,129.5	24.94	100	100
	5th     “     “     “ .....		5,936.4	57.48		
3	4th cross Ayrshires.....	2	5,428.7	42.76	100	100
	5th     “     “     “ .....		6,882.8	56.77		
All ages	Foundation.....	35	5,115.4	32.36	43	29
	1st cross Ayrshires.....		4,838.0	25.97		
“	1st cross Ayrshires.....	49	4,912.7	28.19	38	43
“	2nd     “     “     “ .....		4,906.2	26.83		
“	2nd cross Ayrshires.....	40	5,330.0	34.90	73	80
“	3rd     “     “     “ .....		5,896.5	47.39		
“	3rd cross Ayrshires.....	22	5,222.0	32.87	78	78
“	4th     “     “     “ .....		5,702.6	42.95		
“	4th cross Ayrshires.....	5	4,649.2	32.06	100	
	5th     “     “     “ .....		6,315.0	57.19		

In analyzing the preceding table it is important to keep the following points in mind: (1) That all females, good or bad, were retained in the herd, which would naturally lower the average production per cow; (2) That five or six of the foundation cows responded to good feed and care and proved to be above average producers, one yielding as high as 8,000 pounds of milk, and the average for the foundation herd was 1,000 pounds above the general average given for the dairy cows of the Dominion; (3) That seasonal conditions were a determining factor adversely affecting a comparison. For example, the season of 1915 was a very unfavourable season for crops. Not only was growth poor, but hay was stored in poor condition. A short root crop and poor quality of hay were reflected in the production during the winter of 1915-16. The foundation cows were in their sixth lactation period and first-cross Ayrshires in their fourth lactation period. The former dropped an average of nearly 1,000 pounds of milk per cow over their previous record. Therefore, with the foundation cows having a good year with good crops during their fourth lactation period and their daughters, first-cross Ayrshires, having a poor year for their fourth lactation period, would tend to place the latter at some disadvantage, when compared with their dams on the same lactation period. The seasonal factor has its effect on all comparisons of production of progeny and dam due to the fact that their records are made under varying seasonal conditions over which one has no control; (4) The main point of interest in analyzing these figures is the outstanding evidence of the influence that good sires may have on the herd development. The first two Ayrshire bulls used were “Stonehouse Prince” and “Sterling Silver of Riverside”. The progeny of these two bulls did not, on the average, show an increase in production or profit over feed cost over their dams. In section 2 a more detailed study is given to the pedigree of “Stonehouse Prince” and it is sufficient to say that if he had production back of him, he failed to transmit it to his daughters, but as “Sterling Silver of Riverside” was sired by

a half-brother of "Stonehouse Prince" and carried much of the same breeding, it is quite evident from the production of their progeny, that both these bulls failed to transmit on to their progeny any milking propensities they may have inherited.

The second-cross Ayrshires were sired by four different Ayrshire bulls, "Sterling Silver of Riverside", "Chieftain of Riverside Farm", "Hillside Sally's Boy" and "Fairvue Flashlight". Here again it may be noted that "Sterling Silver of Riverside's" daughters are on the average inferior to their dams in production, while the daughters of "Chieftain of Riverside Farm" are on a par with their dams. The daughters of "Hillside Sally's Boy" and "Fairview Flashlight" are on the average superior to their dams.

In the third, fourth and fifth crosses, all but five females were sired by the following three bulls: "Hillside Sally's Boy", "Springbank King Theodore" and "Ottawa Statesman", and their daughters on the average were superior to their dams.

In the section of this bulletin on "Comparison of Sires" the pedigree of "Springbank King Theodore" is treated in more detail, but the pedigree of each of these three bulls reveal the fact that they were all well bred bulls. Moreover, each demonstrated his ability to transmit to his progeny those milking qualities which he himself has inherited and which are so essential in a herd sire.

The following is a summary of the points of interest to be deducted from the preceding table:—

(1) That there was a marked increase in superiority of daughters over dams, both in production and profit over feed cost.

(2) That this was most marked in the third, fourth and fifth crosses.

(3) That, comparing the progeny of all ages with their dams as two-year-olds, 43 per cent were superior in milk production and only 29 per cent were superior in profit over feed cost, but that the succeeding generation showed a very marked increase of daughters superior to dams in profit over feed cost, indicating that the improved breeding had a marked influence on economical consumption of feeds, which resulted in more profitable production.

(4) That even though the foundation cows proved to be above average producers, there was still plenty of room for improvement.

(5) That it is good business to purchase sires possessing inherited factors for high milk production, together with the prepotency to transmit these factors to their offspring.

(6) That the purchase of a poor sire is a waste of both time and money.

The following summary gives the average increase or decrease in production and profit in each generation expressed on a percentage basis:—

**Table 2.—Average Increase or Decrease in Production in Each Generation**

Generation	Percentage increase or decrease over dams	
	Production F.C.M.	Profit
	%	%
1st cross Ayrshires.....	- 5	-20
2nd cross Ayrshires.....	0	- 5
3rd cross Ayrshires.....	11	36
4th cross Ayrshires.....	9	31
5th cross Ayrshires.....	36	78

The following graphs show the per cent of daughters superior to dams in each age class and for each generation.

### Ayrshire - FAT CORRECTED MILK.



Graph 1.—Percentage of grade Ayrshires superior to their dams in the production of "Fat Corrected Milk".

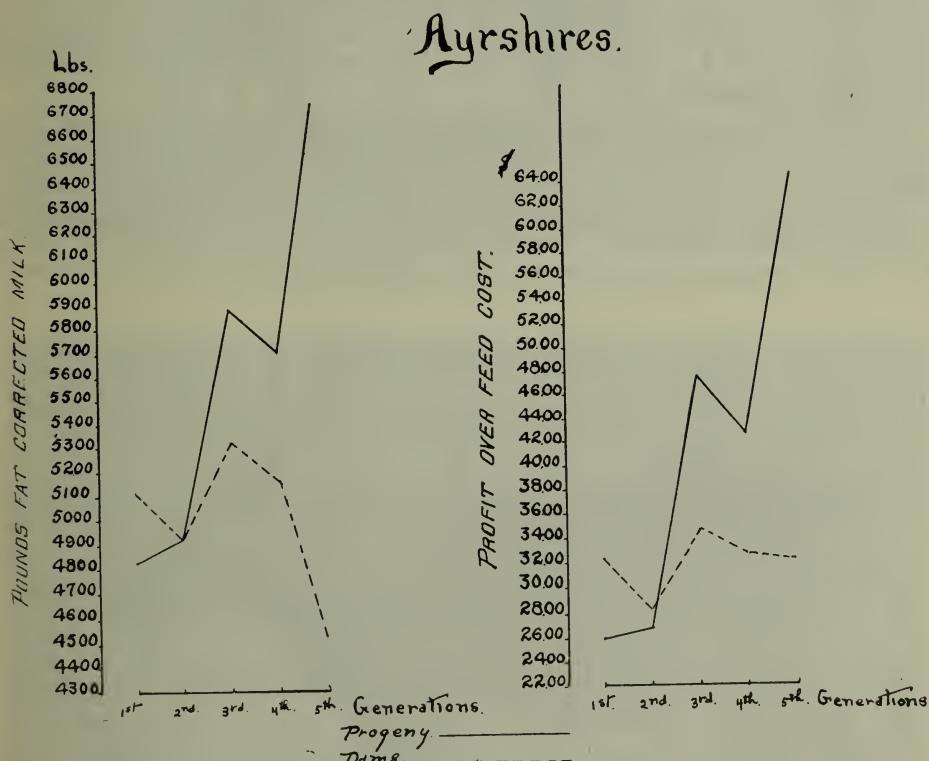
### Ayrshire - PROFIT OVER FEED COST



Graph 2.—Percentage of grade Ayrshires superior to their dams in "Profit over Feed Cost".

A study of these graphs shows the general tendency of the percentage to increase with each generation. This is especially clear in the section "All Ages". In two cases there were no daughters superior to their dams, namely, graph 1, 5-year-old records, first cross and graph 2, 4-year-old records, first cross. A comparison of the two-year-old records is the best index of the value of the pure-bred sire, because of the larger number of records shown here than in any of the other age groups. The decrease in succeeding ages was due to several causes, accident, sickness and the tuberculosis test, all removing a number of animals before completing their five lactation periods. As two-year-olds, there was only one cross, the second, that showed less than 50 per cent of the daughters superior to their dams in F.C.M. produced, and two crosses, first and second, in profit. A fair explanation of this has already been given in the summary of table 1.

Graph 3 shows the average production and profit of all ages for each generation.



Graph 3.—Comparison of Ayrshire daughter and dam records, all ages, for each generation in production of F.C.M., and profit over feed cost.

This study shows at a glance, the increase in production and profit that may be expected by the use of a pure-bred sire, when no particular attention is paid to pedigree, and again when proven ancestry is demanded in the pedigree of the sire chosen. The first generation, sired by the two bulls mentioned above, under table 1, are below their dams in both production and profit, the second generation is practically equal, while a marked increase is noted in the succeeding generations.

### **Biography of Animals Shown in Figures One to Seven**

Figure 1 is "Jessie", one of the foundation cows, a grade Shorthorn, whose two-year-old record was 3,485·9 pounds of fat corrected milk, yielding \$11.70 profit over feed cost.

Figure 2 is "Jessie 1A", a first-cross Ayrshire and is the first daughter of "Jessie" by "Stonehouse Prince". Her two-year-old record was 3,933·6 pounds of fat corrected milk, yielding \$13.60 profit over feed cost.

Figure 3 is "Jessie 1A1", second-cross Ayrshire and the first daughter of "Jessie 1A", was sired by "Chieftain of Riverside". Her two-year-old record was 3,301·9 pounds of fat corrected milk, yielding \$5.33 profit over cost of feed.

Figure 4 is "Jessie 1A12", third-cross Ayrshire, the daughter of "Jessie 1A1", but second calf, sired by "Fairvue Flashlight"; her two-year-old record was 5,103·2 pounds of fat corrected milk, yielding \$30.73 profit over feed cost.

Figure 5 is "Jessie 1A122", fourth-cross Ayrshire. She was a daughter of "Jessie 1A12", sired by "Springbank King Theodore", but a second calf. Her two-year-old record was 4,404 pounds of fat corrected milk, yielding \$30.10 profit over feed cost.

Figure 6 is "Jessie 1A1221", fifth-cross Ayrshire, the first daughter of "Jessie 1A122", sired by "Ottawa Statesman". Her two-year-old record was 6512·1 pounds of fat corrected milk, yielding \$69.34 profit over feed cost.

Figure 7 is "Jessie 1A12211", sixth-cross Ayrshire, the first daughter of "Jessie 1A1221", sired by "Ravenswood Royal". Her two-year-old record was 7,435·2 pounds of fat corrected milk, yielding \$70.98 profit over feed cost.

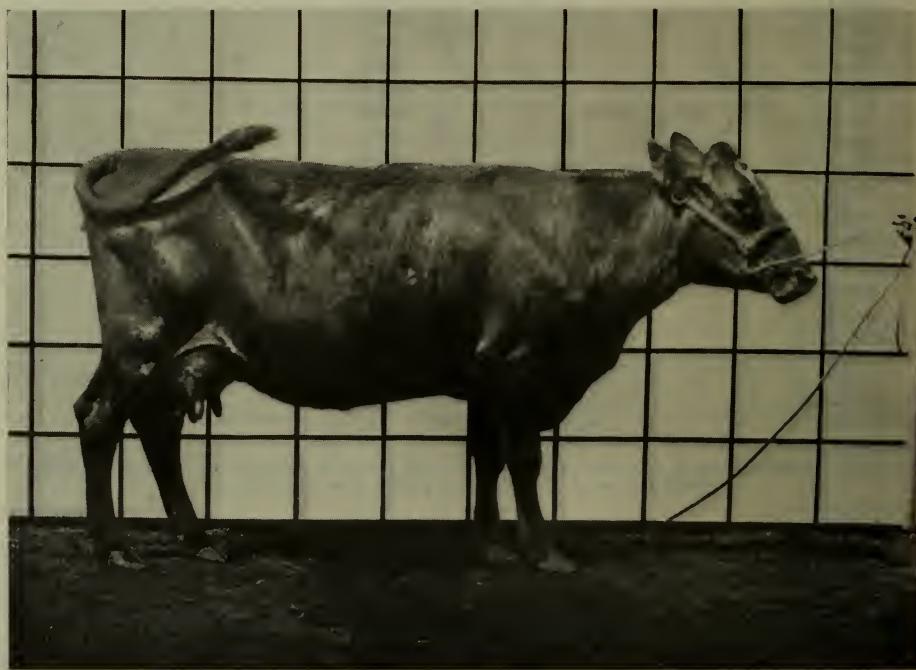


FIG. 1.—Jessie, foundation cow, a grade Shorthorn.

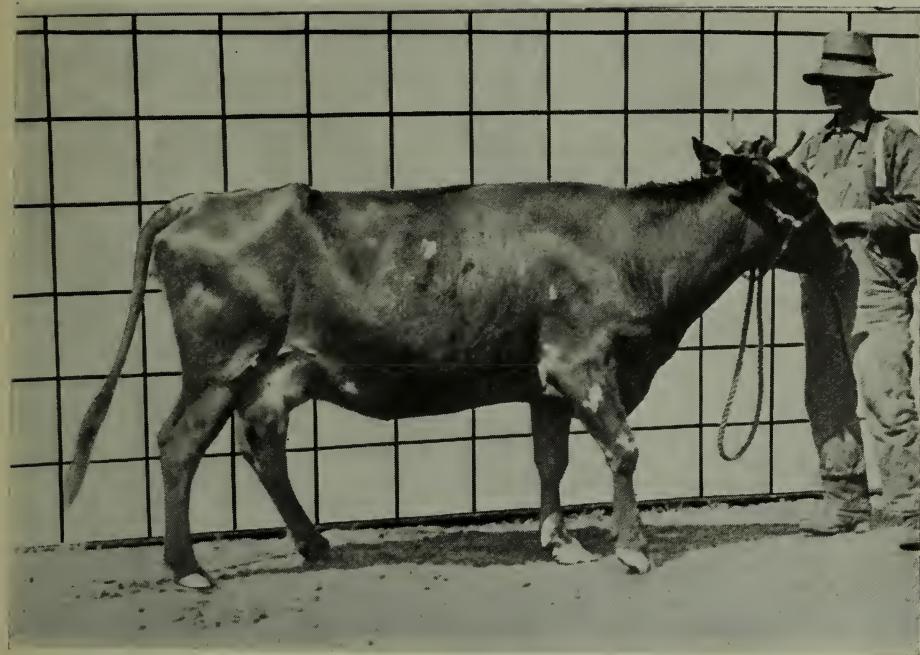


FIG. 2.—Jessie 1A, first-cross Ayrshire, daughter of Jessie.

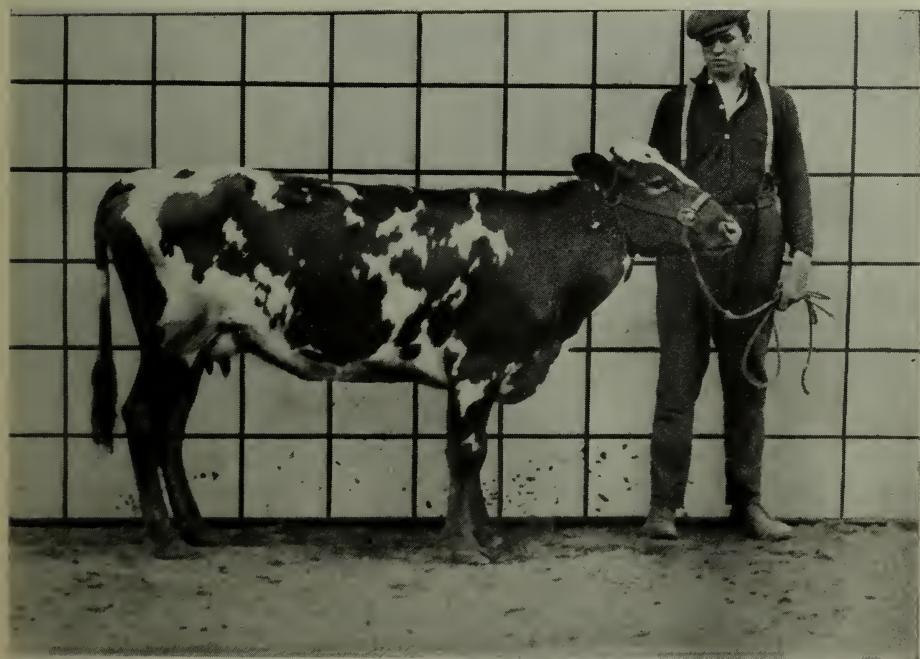


FIG. 3.—Jessie 1A1, second-cross Ayrshire, daughter of Jessie 1A.



FIG. 4.—Jessie 1A12, third-cross Ayrshire, daughter of Jessie 1A1.

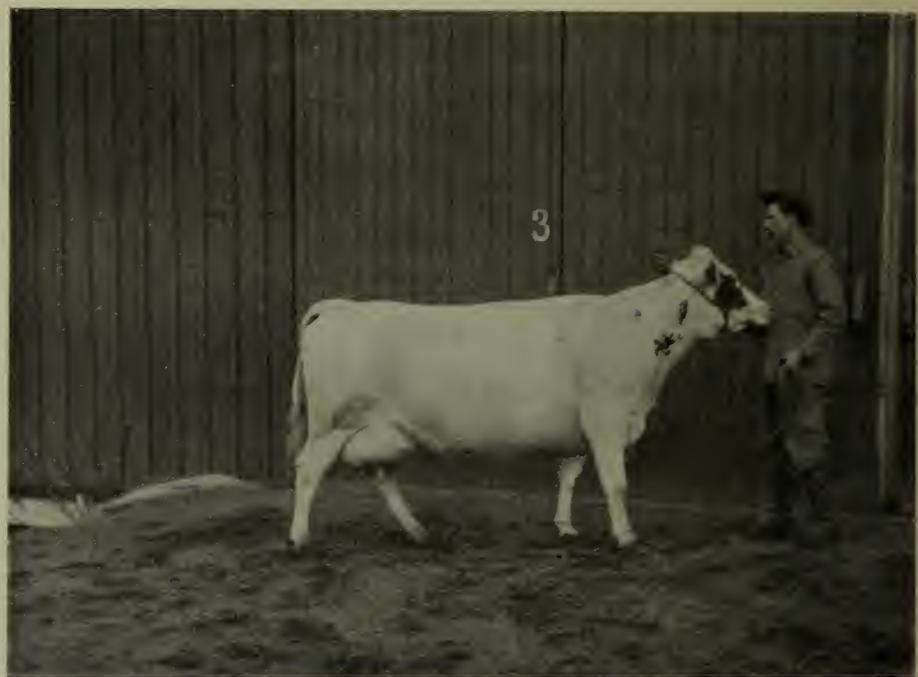


FIG. 5.—Jessie 1A122, fourth-cross Ayrshire, daughter of Jessie 1A12.

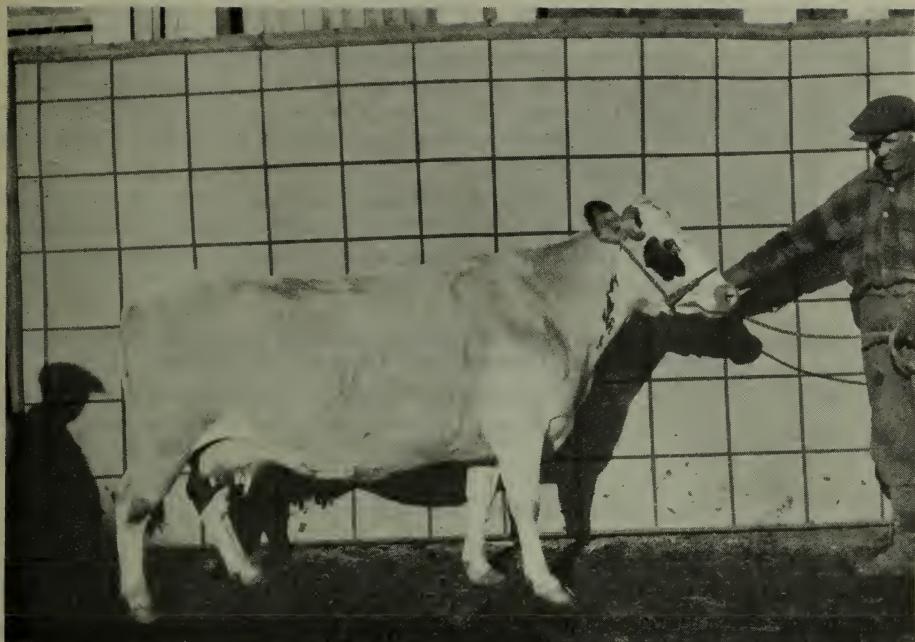


FIG. 6.—Jessie 1A1221, fifth-cross Ayrshire, daughter of Jessie 1A122.

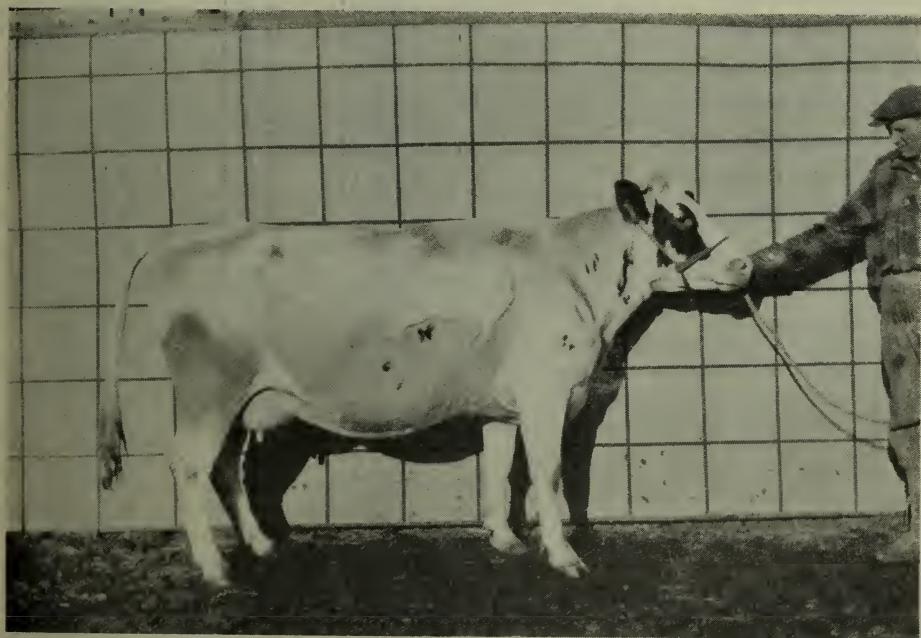


FIG. 7.—Jessie 1A12211, sixth-cross Ayrshire, daughter of Jessie 1A1221.

Figures 1 to 7 demonstrate very nicely the results that one may expect from the use of pure-bred sires. They also bring out very forcibly the value of good proven sires. This phase of the experiment is treated in detail in section two of this bulletin. A noteworthy feature is the marked influence the sires had in this line of breeding, not only in type and colour, but in production in the third, fourth, fifth and sixth crosses. This held true in all families except where there was lack of high milk production inheritance or lack of ability to transmit the same on the part of the sires involved.

The Holstein grades were descended from the same group of foundation cows as were the Ayrshires. Table 3 gives the average production of F.C.M. and profit over feed cost of each age group in each generation developed during the sixteen years of the experiment.

**Table 3.—Comparison of Progeny of Pure-bred Holstein Sires with their Dams on the Bases of "Fat Corrected Milk" Produced and "Profit Over Feed Cost"**

Age	Generation	Number of pairs	Fat corrected milk	Profit	Per cent Progeny Superior to Dams	
					F.C.M.	Profit
2	Foundation cows.....	9	3,826.1	16 04	78	44
	1st cross Holsteins.....		4,429.7	17 19		
3	Foundation cows.....	8	5,447.4	34 00	38	38
	1st cross Holsteins.....		4,349.5	16 03		
4	Foundation cows.....	7	5,609.5	36 56	57	43
	1st cross Holsteins.....		5,350.2	33 34		
5	Foundation cows.....	7	6,406.1	46 67	14	29
	1st cross Holsteins.....		5,341.8	24 78		
6	Foundation cows.....	6	5,057.2	26 53	100	83
	1st cross Holsteins.....		6,381.9	39 62		
2	1st cross Holsteins.....	16	4,352.7	15 20	56	63
	2nd " "		4,466.8	18 82		
3	1st cross Holsteins.....	8	4,595.6	19 10	63	63
	2nd " "		5,199.9	29 68		
4	1st cross Holsteins.....	8	5,857.9	41 01	75	63
	2nd " "		7,548.2	63 11		
5	1st cross Holsteins.....	7	5,338.3	26 82	57	57
	2nd " "		6,792.0	54 23		
6	1st cross Holsteins.....	3	6,297.8	35 70	67	67
	2nd " "		8,602.8	65 96		
2	2nd cross Holsteins.....	20	4,439.1	17 81	55	65
	3rd " "		4,746.1	28 08		
3	2nd cross Holsteins.....	5	5,210.1	28 00	60	60
	3rd " "		5,484.8	39 93		
4	2nd cross Holsteins.....	5	7,203.9	58 68	40	40
	3rd " "		5,438.1	34 89		
5	2nd cross Holsteins.....	1	5,369.8	33 44	100	100
	3rd " "		8,162.0	69 19		
2	3rd cross Holsteins.....	3	3,864.0	16 63	67	100
	4th " "		4,462.3	32 83		
3	3rd cross Holsteins.....	1	5,755.3	39 86	100	100
	4th " "		5,970.1	49 70		
All ages	Foundation cows.....	37	5,201.8	31 30	57	47
	1st cross Holsteins.....		5,075.6	25 07		
"	1st cross Holsteins.....	42	4,989.0	24 26	63	63
	2nd " "		5,876.3	38 59		
"	2nd cross Holsteins.....	31	5,039.4	26 55	55	60
	3rd " "		5,087.1	33 06		
"	3rd cross Holsteins.....	4	4,336.8	22 44	75	100
	4th " "		4,839.3	37 05		

The first-cross females, compared with their dams, showed an increase as two-year-olds and six-year-olds, and decreases in each of the other age classes. These were sired by two bulls, "Artis Jake" and "Sir Segis of Ottawa". The former showed a decrease in the majority of his daughters and his pedigree was

lacking in proven ancestry. A further study is made of his influence on the herd in Section 2. "Sir Segis of Ottawa" showed an increase in the majority of his progeny's records over their dam, but not sufficient to offset the decreases given by the daughters of "Artis Jake".

The second-cross females were sired by three bulls, "Sir Segis of Ottawa", "Royalton Korndyke Hero" and "College Johanna Lad De Kol", all of which gave daughters equal to or superior to their dams.

The third crosses were sired by "College Johanna Lad De Kol", "Home-stead Canary Vale", "Colanthus Mercena Fayne" and "Sir Natoye Gladi". "Colanthus Mercena Fayne" showed the most consistent increase in the production of his daughters over their dams. The fourth-cross females were sired by the latter three bulls named above and were all superior to their dams but one.

In summing up the results as given in the "all ages" section of this table, the average production and profit of the daughters is superior to their dams except with the first cross or first generation group.

Following is the increase or decrease of each generation expressed on the percentage basis:—

**Table 4.—Average Increase or Decrease in Production in Each Generation**

Generation	Percentage increase or decrease over dams	
	Production F.C.M.	Profit
	%	%
1st cross Holstein.....	- 2	-20
2nd cross Holstein.....	18	59
3rd cross Holstein.....	1	25
4th cross Holstein.....	12	65

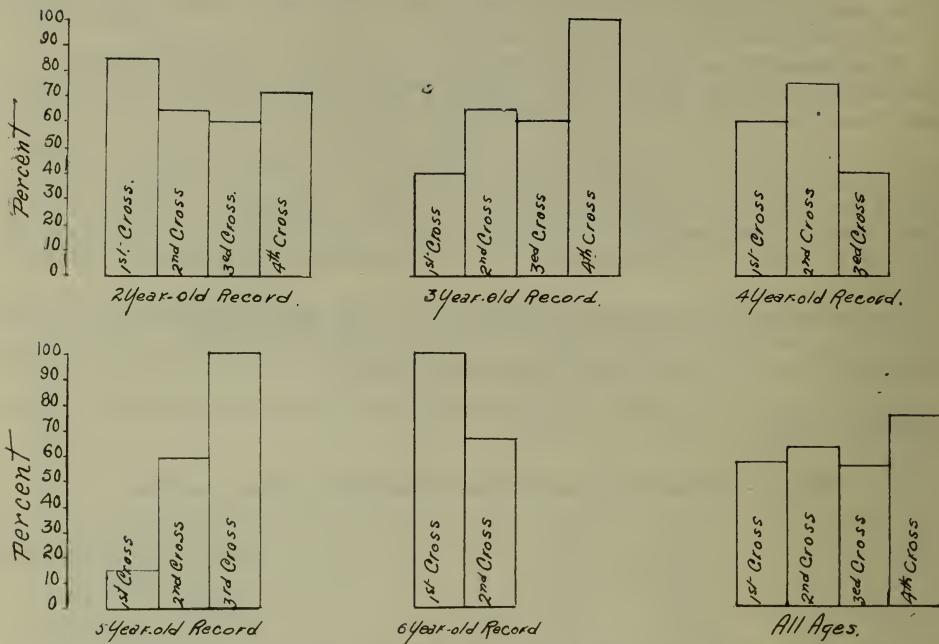
The following graphs present, in the same form as was given in the study of the Ayrshires grades, the percentage of daughters superior to their dams in each age class and for each generation:—

Graph 4 shows that with but three exceptions, over fifty per cent of the grade Holsteins were superior to their dams in F.C.M. produced. In the "All Ages" chart, the average percentage superior is 63, or practically two-thirds of all the records made by these cows were superior to those of their dams of the same age.

In graph 5, the average per cent superior is 68. The two-year-old records were over 50 per cent superior, except the first cross, and the fact that a number of the best producers in this class were prevented from completing further records was, no doubt, a strong factor in reducing this percentage in the other age classes.

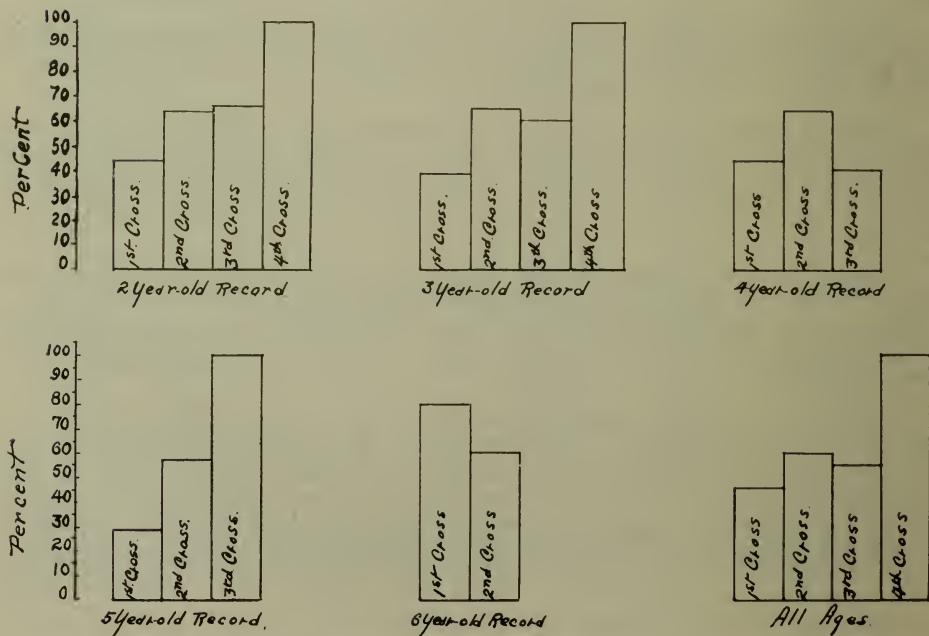
Graph 6 shows the average production of the progeny and dams for each generation of Holstein grades. The production and profit in the second generation class was much higher than in either of the other classes. This is due largely to the records of three exceptionally high producers that left no progeny which have completed more than one record. In no case, however, except in the first generation, was the average of the progeny below that of the dams.

## Holstein - FAT CORRECTED MILK.

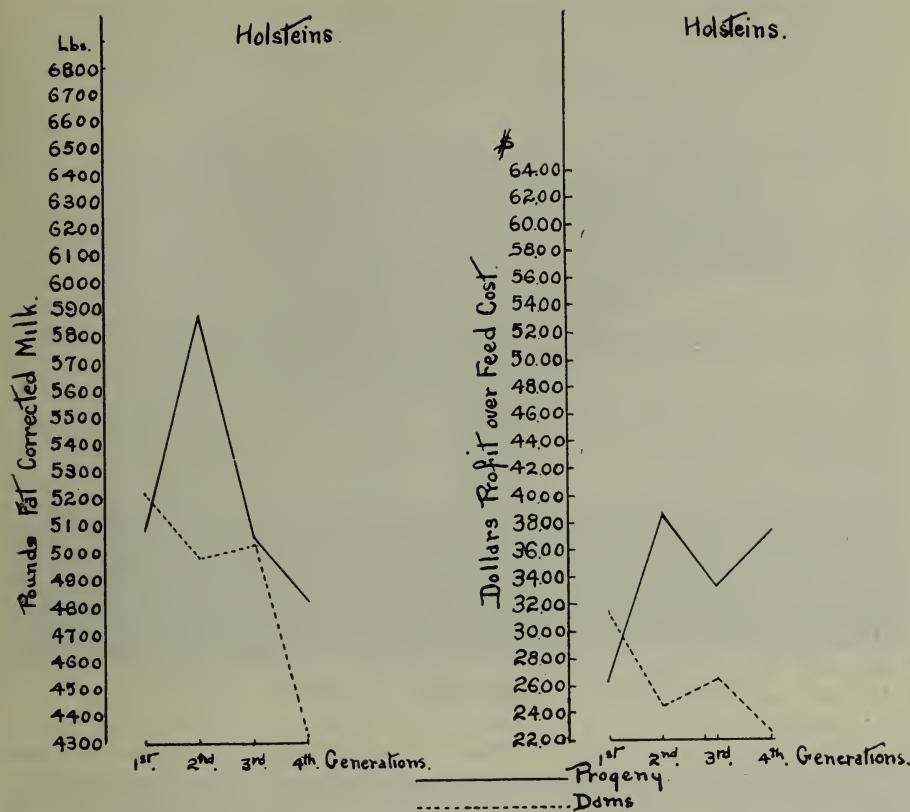


Graph 4.—Percentage of grade Holsteins superior to their dams in the production of "Fat Corrected Milk".

## Holstein - PROFIT OVER FEED COST.



Graph 5.—Percentage of grade Holsteins superior to their dams in "Profit over Feed Cost".



Graph 6.—Comparison of Holstein daughter and dam records, all ages, for each generation, in production of F.C.M. and profit over feed cost.

In the third generation there was only a slight increase in F.C.M. with a much greater increase in profit. This indicates that the third generation grades were able to make better use of their feed and thus produce milk at a lower cost per hundred pounds, a factor equally as important in successful dairying as an increase in production. This point is demonstrated very clearly in graphs 4 and 5, in the two-year-old sections.

Table 5 gives the average production, profit and percentages superior of the combined Ayrshire and Holsteins grades for all ages.

Table 5.—Average of Ayrshire and Holstein Comparisons.

All Ages

Generation	Number of pairs	Average Production		Percent progeny Superior to dams	
		F.C.M.	Profit	F.C.M.	Profit
Foundation.....	72	5,159.8	31 82	50	38
1st cross.....		4,960.1	25 51		
1st cross.....	91	4,947.9	26 38	50	52
2nd cross.....		5,353.9	32 26		
2nd cross.....	71	5,203.1	31 25	65	72
3rd cross.....		5,543.1	41 13		
3rd cross.....	26	5,085.8	31 26	77	80
4th cross.....		5,569.8	43 58		
4th cross.....	5	4,649.2	32 06	100	100
5th cross.....		6,315.0	57 19		

On a percentage basis the increase or decrease and profit was as follows:—

Generation	Percentage increase or decrease over dams	
	F.C.M.	Profit
	%	%
1st cross.....	- 4	- 20
2nd cross.....	8	22
3rd cross.....	7	32
4th cross.....	10	39
5th cross.....	36	78

The foregoing table combines the results of the entire experiment. It is the average of the Ayrshire and Holstein crosses taken from tables 1 and 3 and compared with their dams in production and profit. Regardless of the fact that all females good and poor were retained in the herd, except a few that had to be disposed of on account of injury or disease, the preceding figures show a remarkably high percentage of daughters superior to dams not only in milk production, but in profit over feed cost. Furthermore, it shows that there was a consistent increase in each succeeding generation, especially in profit over feed cost. These percentages are even greater than those given under Mendel's Law of Inheritance, wherein 25 per cent might be expected to be superior to the parents, 25 per cent inferior and 50 per cent equal.

According to the above law of inheritance, at least 25 per cent and possibly 50 per cent of the female progeny of the foundation cows should have been weeded out as being inferior to their dams. In actual practice, some of the poorer foundation cows would also have been weeded out. Had these practices been followed out, the percentage increase in production of the remaining progeny of the foundation cows over their dams would have been considerably higher.

#### **Biography of Animals Shown in Figures 8 to 14—Holsteins**

Figure 8. "Jessie", one of the foundation cows, a grade Shorthorn, from which we were able to select two family lines, one in the Ayrshire and one in the Holstein. Her two-year-old record was 3,485.9 pounds of fat corrected milk, yielding \$11.70 profit over feed cost.

Figure 9 is "Jessie 1H", first-cross Holstein, the second calf of old "Jessie", the foundation cow, and sired by "Artis Jake". Her two-year-old record was 4,224.9 pounds of fat corrected milk, yielding a profit of \$14.48 over feed cost.

Figure 10 is "Jessie 1H4", second-cross Holstein, the first daughter of "Jessie 1H", sired by "Royalton Korndyke Hero", a proven sire that was worth a lot of money to head any herd. His daughters were all good. "Jessie 1H4's" two-year-old record was 7,752.8 pounds of fat corrected milk, yielding a profit of \$62.05 over feed cost. This cow also had a four-year-old record of 11,243.2 pounds of fat corrected milk, yielding a profit of \$114.54, over feed cost, against her dam's record at the same age of 4645.8 pounds milk, yielding a profit of \$21.01 over feed cost. Again, in the five-year-old form she produced 14,324 pounds of fat corrected milk, yielding a profit of \$162.13 over feed cost, versus her dam at the same age, with 5,199 pounds, yielding a profit of \$15.98. See figure No. 13 for a half sister sired by the same bull, "Royalton Korndyke Hero". This bull's daughters were 100 per cent superior to their dams at the same age.

Figure 11. "Myrtle", another one of the foundation cows, a Shorthorn grade, with some of the old brindle blood mixed in. Her two-year-old record was 3,560.9 pounds of fat corrected milk, yielding a profit of \$13.65 over feed cost.

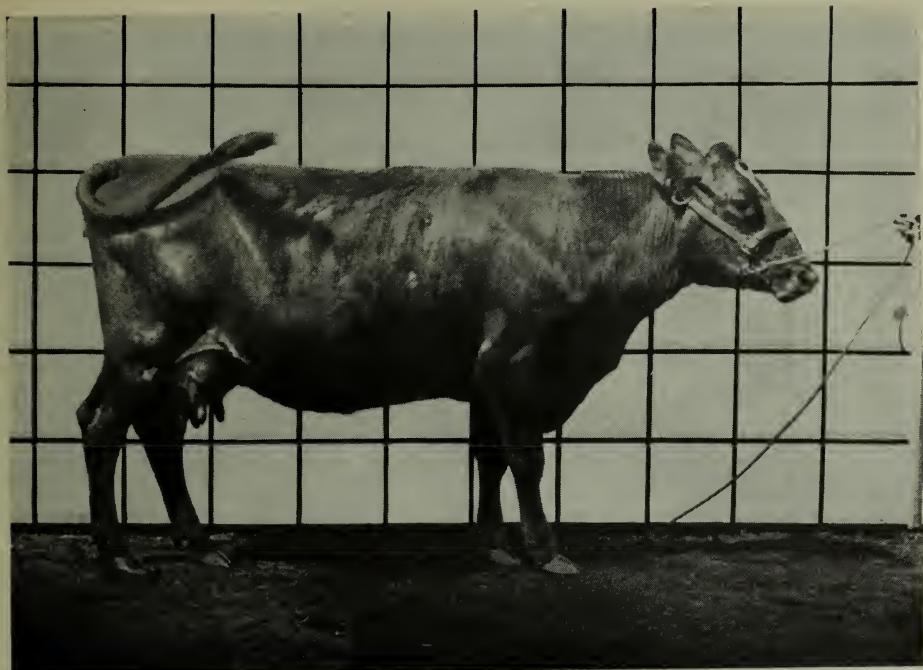


FIG. 8.—Jessie, foundation cow, a grade Shorthorn.



FIG. 9.—Jessie 1H, first-cross Holstein, daughter of Jessie.



FIG. 10.—Jessie 1H4, second-cross Holstein, daughter of Jessie 1H.

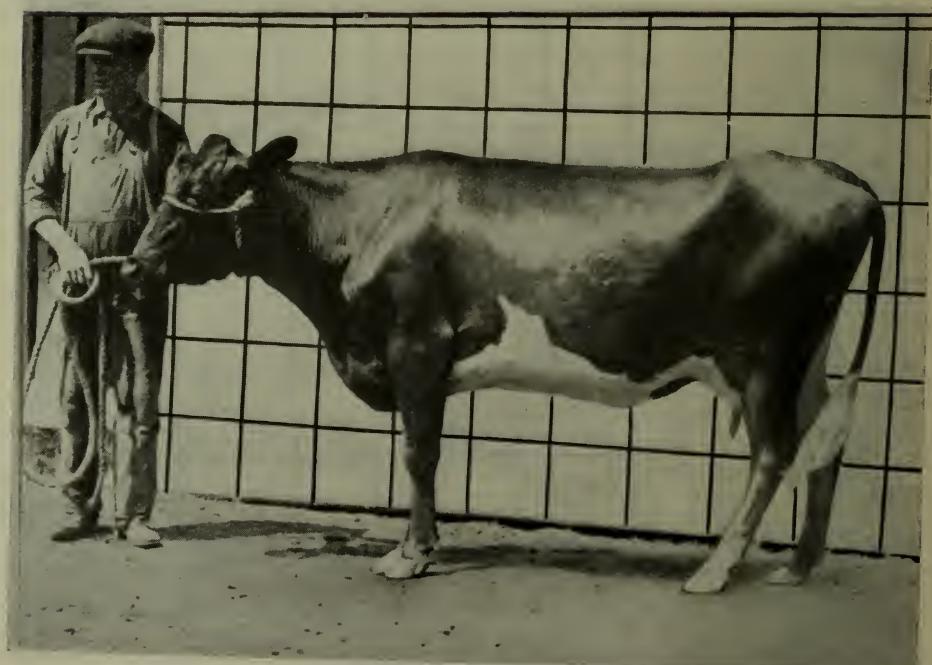


FIG. 11.—Myrtle, foundation cow, a grade Shorthorn.

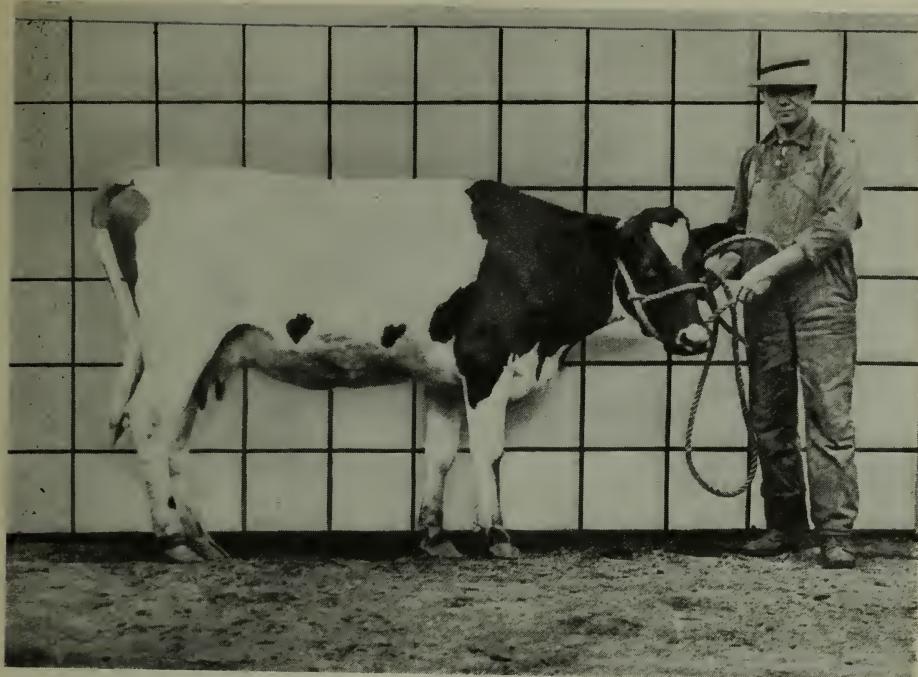


FIG. 12.—Myrtle 1H, first-cross Holstein, daughter of Myrtle.

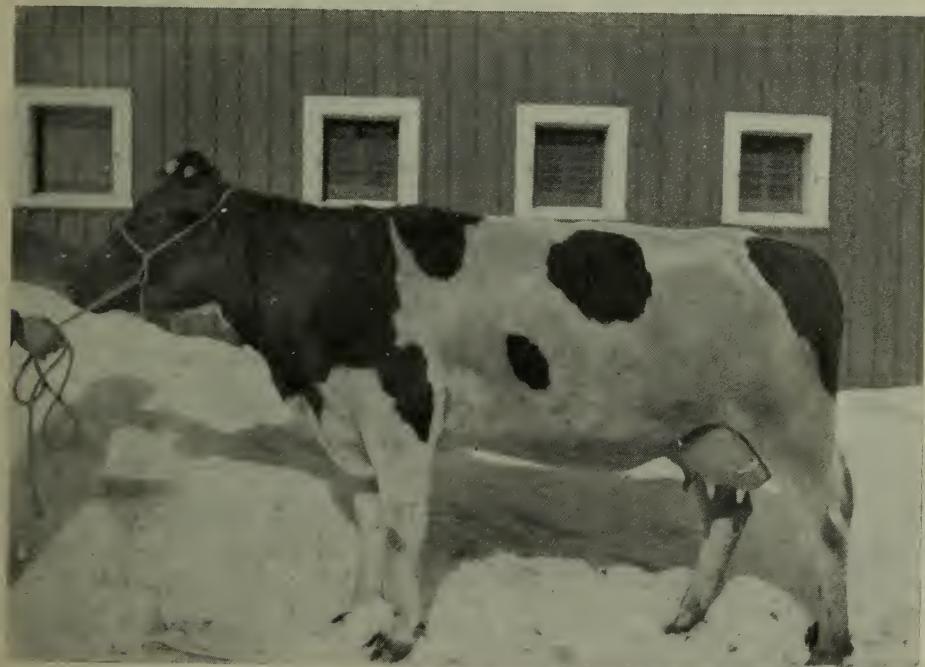


FIG. 13.—Myrtle 1H4, second-cross Holstein, daughter of Myrtle 1H.



FIG. 14.—Myrtle 1H42, third-cross Holstein, daughter of Myrtle 1H4.

Figure 12 is "Myrtle 1H", first-cross Holstein, a daughter of "Myrtle" and sired by a pure-bred Holstein bull, "Artis Jake". Her two-year-old record was 4,085.5 pounds of fat corrected milk, yielding a profit of \$10.57 over feed cost.

Figure 13 is "Myrtle 1H4", second cross Holstein, sired by "Royalton Korn-dyke Hero" and a daughter of Myrtle 1H. Her two-year-old record was 5,285.8 pounds of fat corrected milk, yielding a profit of \$29.96 over feed cost. This heifer is a half sister to "Jessie 1H4", sired by the same bull.

Figure 14 is "Myrtle 1H42", third cross Holstein, sired by "Colanthus Mercena Fayne" and a daughter of "Myrtle 1H4". Her two-year-old record was 6,168.7 pounds of fat corrected milk, yielding a profit of \$42.98 over feed cost.

Figures 13 and 14 again demonstrate the value of good sires, especially those having inherited milking qualities and the prepotency necessary to transmit the same to their progeny.

#### Biography of Animals in Figures 15 and 16

Figure 15—"Myrtle 1HS4", second-cross and second crop of Holsteins, sired by Colanthus Mercena Fayne and daughter of "Myrtle 1HS", and a grand daughter of old "Myrtle", the foundation cow, shown in figure 11. Her two-year-old record was 4,734.3 pounds of fat corrected milk, yielding a profit of \$16.29 over feed cost. She was also the winner in the dairy test at the Maritime Winter Fair in 1925, with 186.4 pounds of milk, 6.85 pounds of fat, with a total score of 218.59 points for the 72 hours on test. Note the splendid type of this cow; she is a real Holstein.

Figure 16 is "Myrtle 1HS43", third-cross Holstein, sired by "Johanna Perfect Posch" and a daughter of "Myrtle 1HS4". Her two-year-old record was not completed here, but she was a very promising heifer. She had 3,752 pounds of fat corrected milk in 79 days and gave evidence of being a much better producer than her dam at the same age.

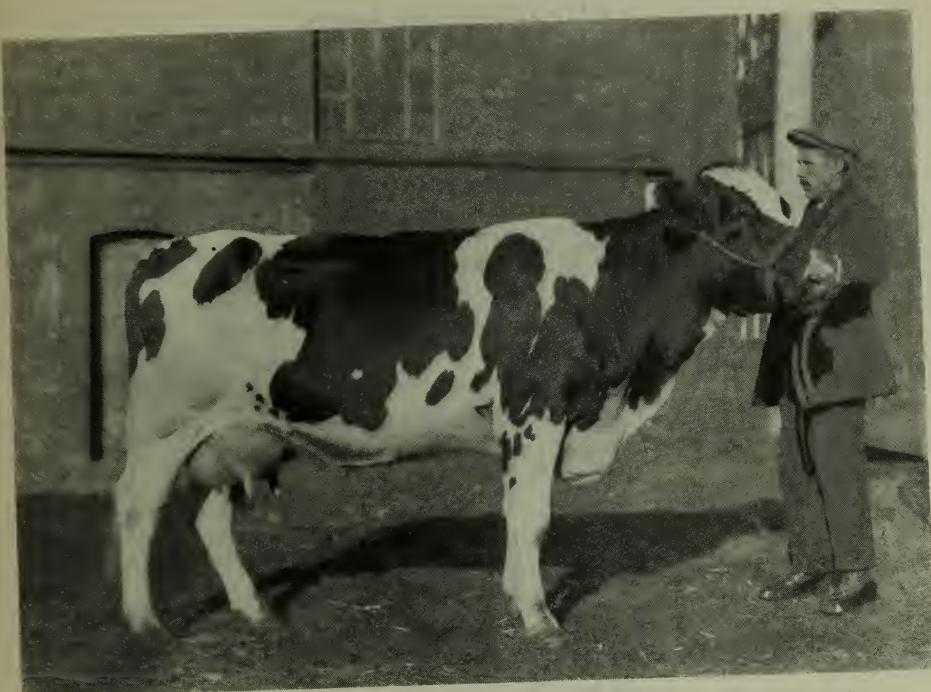


FIG. 15.—Myrtle 1HS4, second-cross and second crop daughter of Myrtle 1H, a first-cross Holstein.

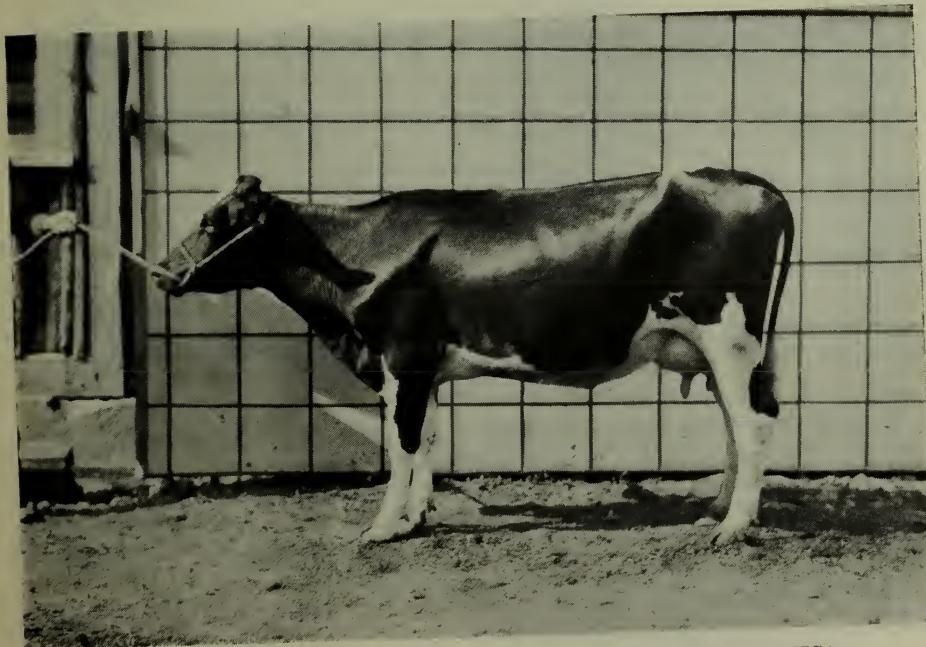


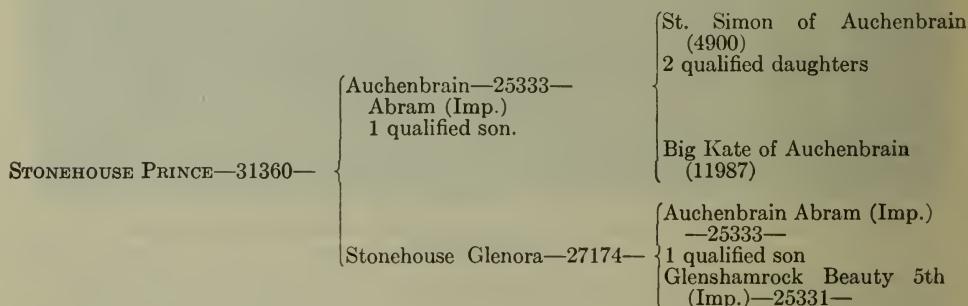
FIG. 16.—Myrtle 1HS43, third-cross Holstein, daughter of Myrtle 1HS4.

## COMPARISON OF Sires

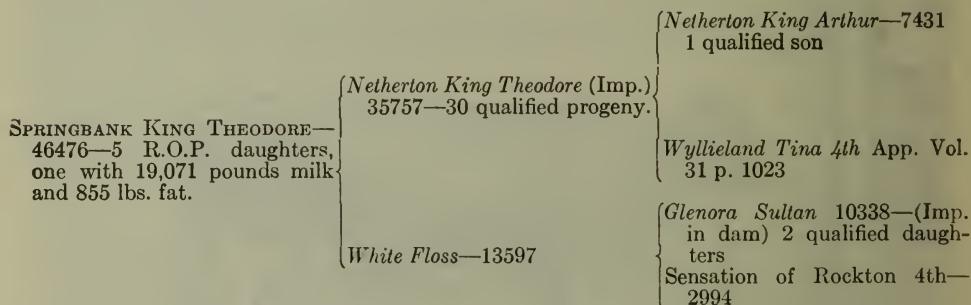
The data studied in section 1 have shown very conclusively the improvement that can be made with the average grade herd of cows by using pure-bred sires. The results would have been more striking had the policy been adopted of selecting only the most promising females from each cross. In this section is presented the analysis of the breeding results of four bulls, two Ayrshires and two Holsteins, which were used in this experiment. This analysis brings out very clearly the importance of very careful selection of the herd sires, if consistent progress is to be made in the breeding operations. The four bulls represent two classes of pure-bred sires; one, the unproven sire, with a plain pedigree, so to speak; the other, a proven sire backed by official records.

The following are the pedigrees of the two Ayrshires, "Stonehouse Prince" and "Springbank King Theodore" respectively.

"Stonehouse Prince" was an Ayrshire sire of good type. His pedigree was as follows:—

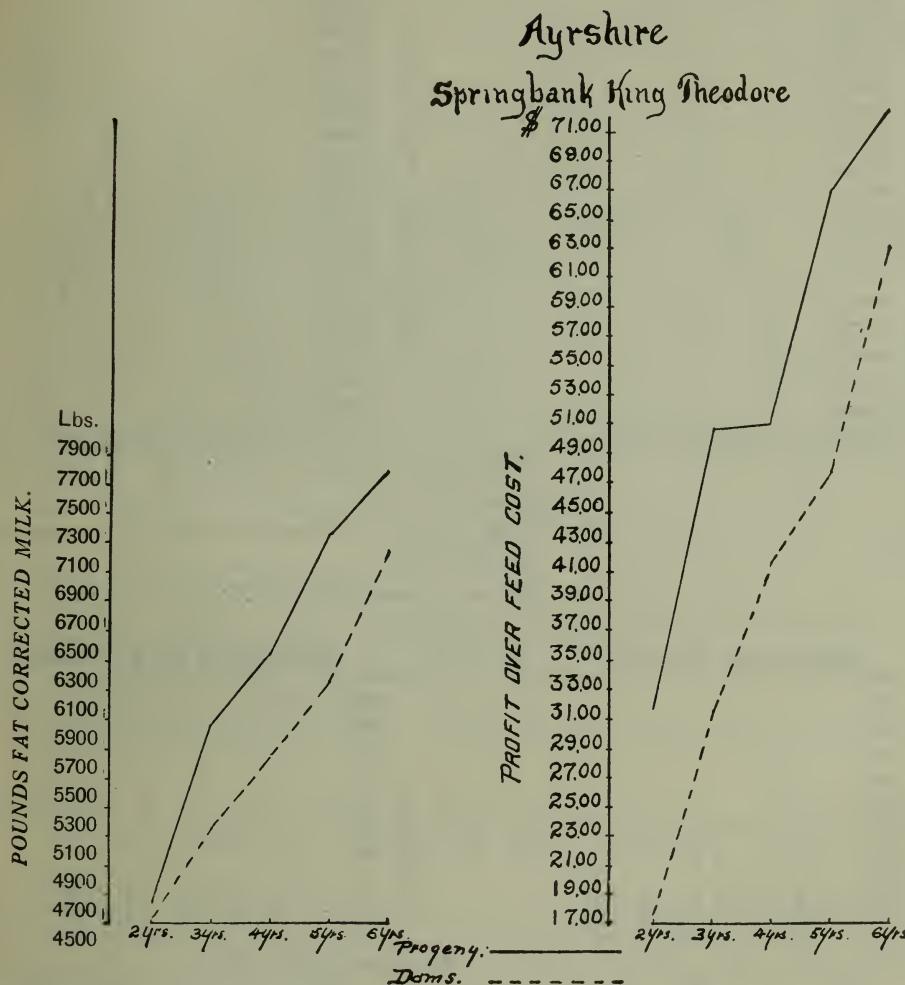


The other Ayrshire sire selected was "Springbank King Theodore-46476—". His pedigree is given below:—



In comparing these two pedigrees it is not difficult to decide the superiority so far as official records go. While neither of their dams had official records, yet "Springbank King Theodore" had five qualified daughters and thirty half-sisters and half-brothers qualified; in other words, he was a proven sire. "Stonehouse Prince's" pedigree shows his sire with one qualified son and grand sire with two qualified daughters.

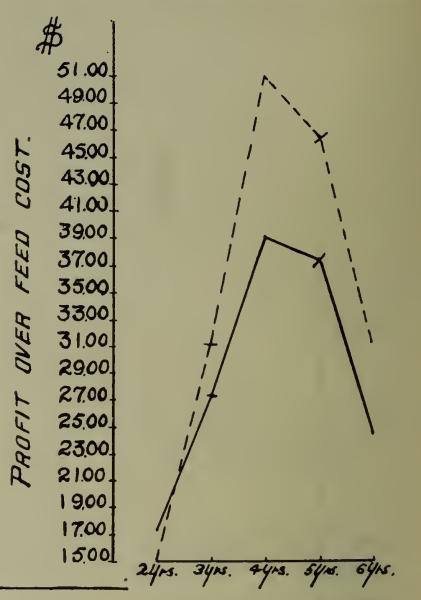
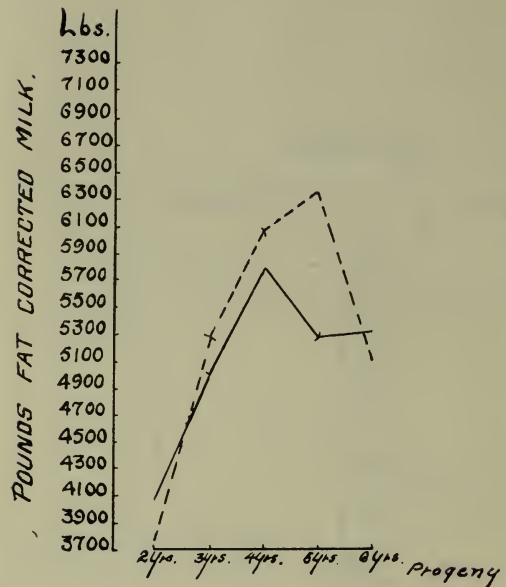
The following graphs present graphically the results obtained from these two bulls in the grading-up experiment:—



Graph 7.—Average production and profit of daughters of "Springbank King Theodore" as compared with their dams.

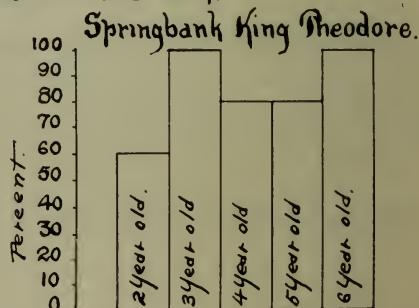
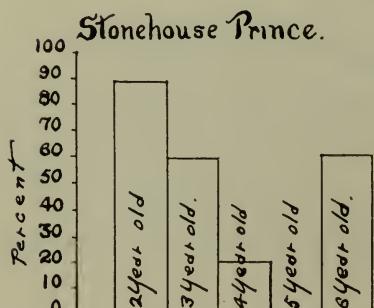
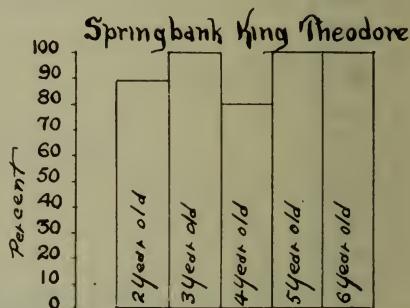
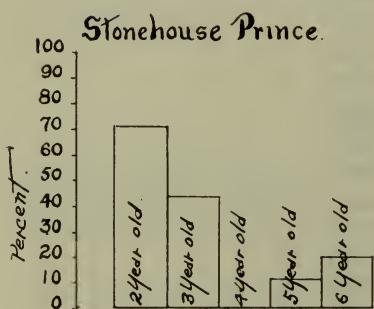
# Ayrshire

## Stonehouse Prince



Graph 8.—Average production and profit of daughters of "Stonehouse Prince" as compared with their dams.

## PROFIT OVER FEED COST



Graph 9.—Comparison of Ayrshire sires on basis of percentage of daughters superior to dams in production of F.C.M., and profit over feed cost.

The following table gives the average increase or decrease in production and profit of the daughters' records as compared with their dams' for each of the five lactations:—

**Table 6.—Records of Daughters of Stonehouse Prince and Springbank King Theodore**

Age	Stonehouse Prince		Springbank King Theodore	
	F.C.M.	Profit	F.C.M.	Profit
2 years.....	lb. 238.4	\$ 1 67	lb. 107.6	\$ 14 24
3 years.....	-239.2	-4 03	735.0	19 00
4 years.....	-256.8	-11 13	712.1	9 40
5 years.....	-1,078.0	-9 09	1,145.3	19 48
6 years.....	183.1	-7 84	574.2	8 32
Total.....	—1,152.5	—30 42	3,274.2	70 44

Graphs 7 and 9 show very clearly the consistent increase in both production and profit of the daughters of "Springbank King Theodore" over that of their dams, while graphs 8 and 9 show that the daughters of "Stonehouse Prince" were not consistent in their production. They were slightly superior as two-year-olds, but were inferior in the succeeding periods until they reach fifth lactation, where they again showed a slight superiority in milk production only. Comparing the average production and profit of "Springbank King Theodore's" progeny with that of their dams, it will be noted that they show an average increase of 3274.2 pounds of milk; likewise, an average increase in profit of \$70.44 per cow over their dams in five lactations. On the other hand the progeny of "Stonehouse Prince" show an average decrease of 1152.5 pounds of milk; likewise an average decrease of \$30.42 in profit over feed cost when compared with their dams in five lactations. These results are very striking. It is true that the dams were not the same in each case, but the average difference in their dams was only 252 pounds of milk, while the daughters of "Springbank King Theodore" had an average of 1720.6 pounds of milk more per lactation than the daughters of "Stonehouse Prince". It appears logical to credit this marked increase very largely to the inherited factor for milk production and prepotency of the sire.

A similar analysis was made of two Holstein bulls, "Artis Jake" and "Royalton Korndyke Hero".

#### **Biography of Animals Shown in Figures 17 to 20, All of Which Were Sired by "Springbank King Theodore"**

Figure 17.—"Jessie 1A51," third-cross Ayrshire, out of "Jessie 1A5". Her two-year-old record was 5,278.8 pounds of fat corrected milk, yielding a profit of \$51.86 over feed cost, versus her dam, "Jessie 1A5," with 4890.7 pounds milk, yielding a profit of \$29.27 over feed cost.

Figure 18.—"Jessie 1A122," fourth-cross Ayrshire, out of "Jessie 1A12". Their two-year-old records were 4404 pounds of fat corrected milk, yielding \$30.10 profit over feed cost, and 5103.2 pounds of fat corrected milk, yielding \$30.70 profit over feed cost, respectively.

Figure 19.—"Bell 1AS12," third-cross Ayrshire, but second crop, out of "Bell 1AS1". Her two-year-old record was 5058.1 pounds of fat corrected milk, yielding a profit of \$37.35 over feed cost, versus her dam at the same age with 4437.8 pounds of fat corrected milk, yielding a profit of \$14.21 over feed cost.

Figure 20.—"Spot 1A42," third-cross Ayrshire, out of Spot 1A4". Her two-year-old record was 4,880.4 pounds of fat corrected milk yielding a profit of \$35.92 over feed cost, versus her dam, "Spot 1A4," with 4463.0 pounds milk, yielding a profit of \$16.44 over feed cost.



FIG. 17.—Jessie 1A51, third-cross Ayrshire, daughter of Jessie 1A5, and sired by Springbank King Theodore.



FIG. 18.—Jessie 1A122, fourth-cross Ayrshire, daughter of Jessie 1A12, and sired by Springbank King Theodore.



FIG. 19.—Bell 1AS12, third-cross Ayrshire, daughter of Bell 1AS1 and sired by Springbank King Theodore.



FIG. 20.—Spot 1A42, third-cross Ayrshire, daughter of Spot 1A4 and sired by Springbank King Theodore.

These four daughters of "Springbank King Theodore" illustrate exceedingly well what a proven sire will do toward building up a herd of dairy cows, uniform in type and colour, as well as showing a consistent increase in production in his progeny, as compared with their dams. His daughters have shown the following results: As two-year-olds, 63 per cent were superior in fat corrected milk and 88 per cent in profit over their dams at the same age. As three-year-olds, 100 per cent were superior in both milk and profit over their dams. As four and five-year-olds, 80 per cent were superior to their dams at the same age. As six-year-olds they were 100 per cent superior to their dams in both milk and profit over feed cost.

#### PEDIGREE OF "ARTIS JAKE"

ARTIS JAKE—4765—

<i>Artis Mercedes Posch</i> (2851)	<i>Sir Abbekirk Posch</i> (1244)
	9 R.O.M. daughters
	18 R.O.M. sons
<i>Jacoba Emily</i> (2561)	<i>Artis Mink Mercedes</i> (1942)
	<i>Carlotta's Netherland</i> (9676) (HFHB)
	1 R.O.M. daughter
<i>Rag Apple Korndyke 5th</i> 67210A	<i>Jacoba H</i> (2933) (H.H.B.)
1 R.O.M. daughter	
5 R.O.M. sons	
14 years—463 pounds milk 18·02 pounds butter in 7 days.	

#### PEDIGREE OF "ROYALTON KORNDYKE HERO"

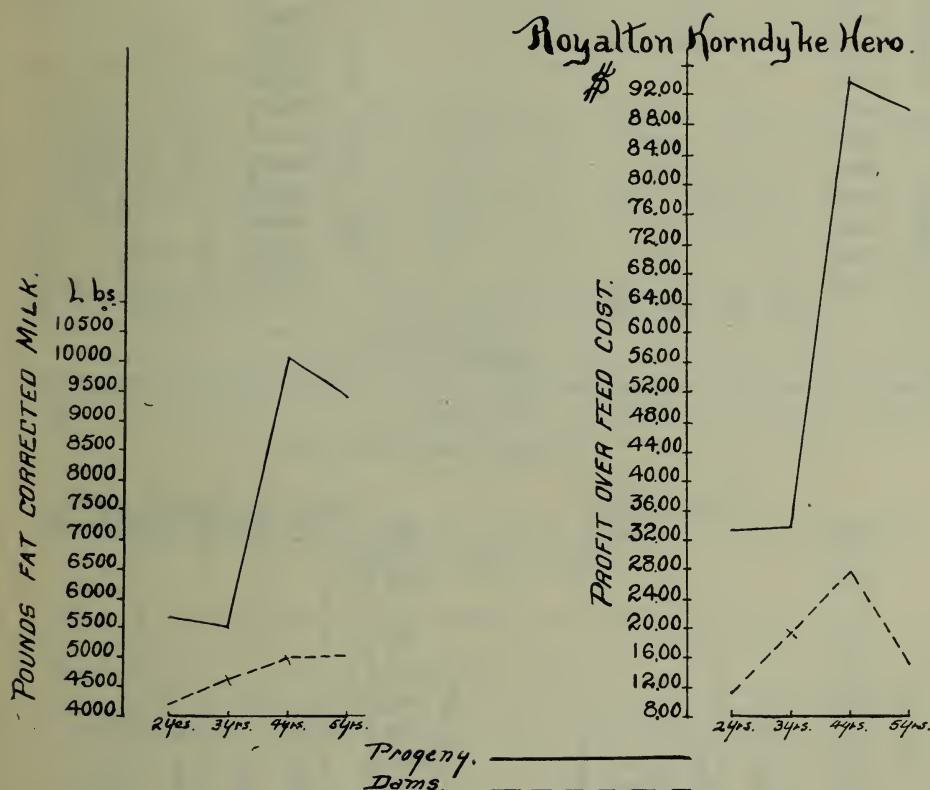
ROYALTON KORNDYKE HERO  
(105385)

1 R.O.P. daughter  
mature 365 days  
16,015 pounds milk  
582 pounds fat  
Half sister to Royalton Can-  
ary Queen  
6 years 365 days  
16,600 pounds milk  
522 pounds fat

<i>Rag Apple Korndyke 5th</i> 67210A	<i>Rag Apple Korndyke</i> 48020A
	27 A.R.O. daughters
	13 A.R.O. sons
<i>Royalton DeKol Calla</i> 86461A	<i>Pontiac Clothilde Korndyke</i> 2nd 92697A
5 years 706·5 pounds milk 31·8 pounds fat in 7 days	
3 tested daughters	
2 proven sons	
Half sister with 29949·9 pounds milk	
1,036 pounds fat in 365 days	
	<i>Paul DeKol Royalton</i> 32899A
	8 A.R.O. daughters
	1 A.R.O. son
	<i>Queen of Royalton</i> 3rd 62730A

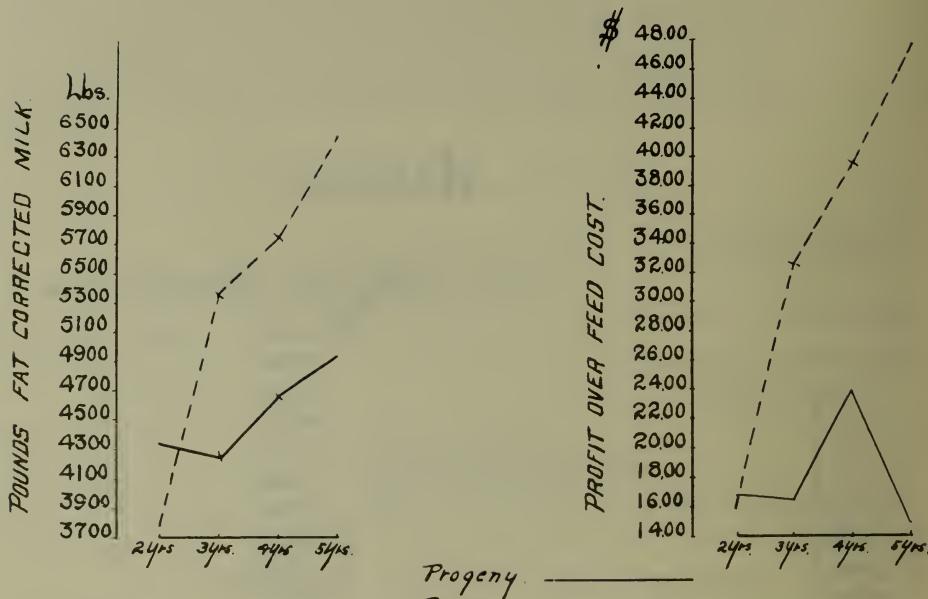
In comparing the preceding pedigrees, it is easy to see that "Royalton Korndyke Hero" has the production back of him in official records to warrant his selection over "Artis Jake," as a herd sire. The following graphs bear out this evidence very clearly:—

# Holstein



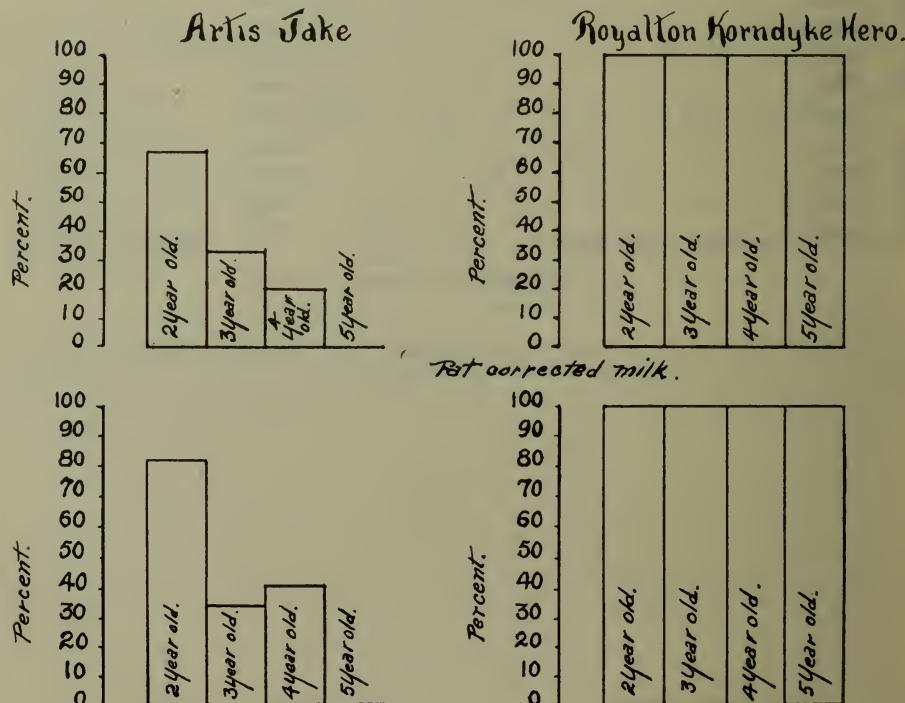
Graph 10.—Average production and profit of daughters of "Royalton Korndyke Hero" as compared with their dams

# Holstein Artis Jake.



Graph 11.—Average production and profit of daughters of "Artis Jake" as compared with their dams.

Profit over feed cost.



Graph 12.—Comparison of Holstein sires on basis of percentage of daughters superior to dams in production of F.C.M., and profit over feed cost.

The following table gives the average increase or decrease in production and profit of the daughters' records as compared with their dams' for each lactation and also the total for four lactations:—

**Table 7.—Records of the Daughters of Artis Jake and Royalton Korndyke Hero**

Age	Artis Jake		Royalton Korndyke Hero	
	F.C.M.	Profit	F.C.M.	Profit
	lb.	\$	lb.	\$
2 years.....	530.2	1 08	1,663.2	22 37
3 years.....	-1,309.5	-15 82	1,045.5	14 95
4 years.....	-1,175.0	-15 77	5,222.7	65 98
5 years.....	-1,522.6	-33 02	4,334.8	74 60
Total.....	-3,476.9	-63 53	12,266.2	177 90

Graphs 10 and 12 show very decidedly the consistent breeding of "Royalton Korndyke Hero". In graph 10 note the high average production and profit of "Royalton Korndyke Hero's" daughters when compared with their dams at the same age, as against the showing made in graph 11 by the daughters of "Artis Jake". The latter sire's daughters were not consistent, nor were they nearly as good producers as their dams on the average as shown in table 7. There it will be noted that "Artis Jake's" daughters showed an average decrease of 3476.9 pounds of milk and \$63.53 less profit over feed cost than their dams in four lactation periods, while the daughters of "Royalton Korndyke Hero" showed an average increase of 12,266.2 pounds milk and \$177.90 profit over feed cost greater than their dams for four lactations. Graph 12 shows still more decidedly the consistency of the performance of "Royalton Korndyke Hero's" daughters as compared with the performance of those of "Artis Jake".

#### **PREVIOUS WORK RELATED TO THAT WHICH IS OUTLINED IN THIS PUBLICATION**

There have been several experiments conducted along the line of this project, which are worthy of note.

McCandlish (2) reported in 1920 the results of an experiment conducted at Ames, Iowa, in which he showed that the average increase in production of milk and butter-fat with first generation grades over their dams, (chiefly scrub beef cows), was 55 and 44 per cent respectively. The second generation showed an increase of 116 per cent in production of milk and 106 per cent in butter-fat over their scrub grand dams. These grades were sired by pure-bred sires of the Holstein, Guernsey and Jersey breeds.

Olson and Biggar (3) reported in 1922 the results of an experiment carried on in South Dakota. They show an increase the first generation of 61 per cent in milk and 52 per cent in butter-fat over the scrub foundation stock (grade beef cows) and 51 and 57 per cent increase respectively for the second generation over their scrub granddams.

These experimenters report on only a few individuals, but their results bear out those obtained in this experiment and show that the use of pure-bred dairy sires will improve the production of the herd, providing these sires are bred along high milk production lines.

## SUMMARY

The results of this experiment may be summarized as follows:—

1. That a profitable high-grade herd of dairy cows may be built up from the common grade herd of inferior breeding by the use of carefully selected pure-bred sires.
2. That it is economy to purchase only proven sires, or sires with proven ancestry within the first three generations.
3. That the purchase of pure-bred sires, without due consideration of their breeding, is a dangerous business practice and may result in not only decreased profits, but the loss of many years of hard work.
4. That it pays to weed out a few of the unprofitable cows each year. Breeding to the most profitable individual means that more rapid progress can be made in building up a profitable herd.
5. That breeding counts not only in the improvement in type and colour, but likewise in the economic consumption of feeds, as demonstrated in the third, fourth and fifth generations.
6. That the herd sires play a very important part in the improvement of the herd, is exceedingly well demonstrated in the various cuts illustrating the families. Note the way these pure-bred sires of each breed transmitted to their progeny the breed type, colour and other characteristics.

## References Cited

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- (3) Olson, T. O. and Biggar, G. C. "Influence of Pure-bred Dairy Sires" South Dakota Agr. Exp. Sta., Bul. 198, 1922.







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